General Mission Analysis Tool (GMAT)

Product Description

http://gmat.gsfc.nasa.gov

08/02/07

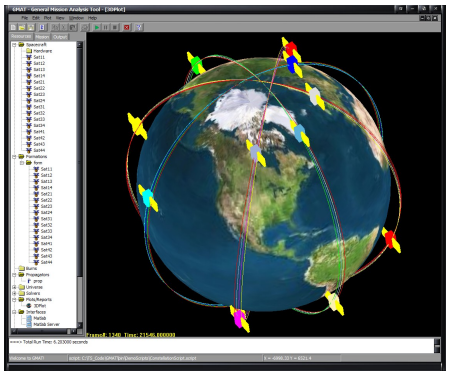
Thinking Systems, Inc.

Introduction

The General Mission Analysis Tool (GMAT) is a space trajectory optimization and mission analysis system developed by NASA and private industry in the spirit of the NASA Mission. GMAT contains new technology and is a testbed for future technology development.

The goal of the GMAT project is to develop new space trajectory optimization and mission design technology by working inclusively with ordinary people, universities, businesses, and other government organizations, and to share that technology in an open and unhindered way. GMAT is a free and open source software system licensed under the NASA Open Source Agreement: free for anyone to use in development of new mission concepts or to improve current missions, freely available in source code form for enhancement or further technology development.

System Description

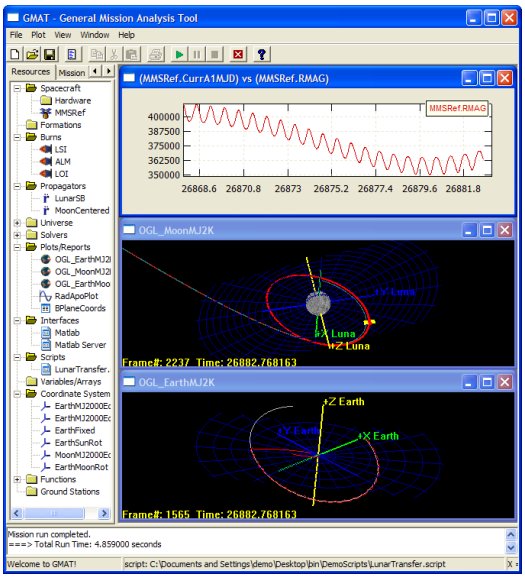


GMAT is an open source, platform independent trajectory optimization and design system system. We use an open source process to permit anyone to develop and validate new algorithms and to enable new algorithms to quickly transition into the high fidelity core.

GMAT is designed to model and optimize spacecraft trajectories in flight regimes ranging from low Earth orbit to lunar applications, interplanetary trajectories, and other deep space missions. The system supports constrained and unconstrained trajectory optimization and built-in features make defining cost and constraint functions trivial so analysts can determine how their inclusion or exclusion effects solutions.

The system also contains initial value solvers (propagation) and boundary value solvers and efficiently propagates spacecraft either singly or coupled. GMAT's propagators naturally synchronize the epochs of multiple vehicles and shorten run times by avoiding fixed step integration or interpolation to synchronize epochs of spacecraft

A user can interact with GMAT using either a graphical user interface (GUI) or script language that has a syntax similar to the MathWorks' MATLAB®[1] system. All of the system elements can be expressed through either interface and users can configure elements in the GUI and then view the corresponding script, or write script and load it into GMAT.



Analysts model space missions in GMAT by first creating resources such as spacecraft, propagators, and optimizers to name a few. These resources can be configured to meet the needs of specific applications and missions. After the resources are configured they are used in the mission sequence to model the motion of spacecraft and simulate events in a mission's time evolution. The mission sequence supports commands such as Nonlinear Constraint, Minimize, Propagate, Function Calls, Inline Math, and Script Events among others.

The system can display trajectories in space, plot parameters against one another, and save parameters to files for later processing. The trajectory and plot capabilities are fully interactive, plotting data as a mission is run and allowing users to zoom into regions of interest. Trajectories and data can be viewed in any coordinate system defined in GMAT, and GMAT allows users to rotate the view and set the focus to any object in the display. The trajectory view can be animated so users can watch the evolution of the trajectory over time.

1 MATLAB is a registered trademark of The MathWorks, Inc.

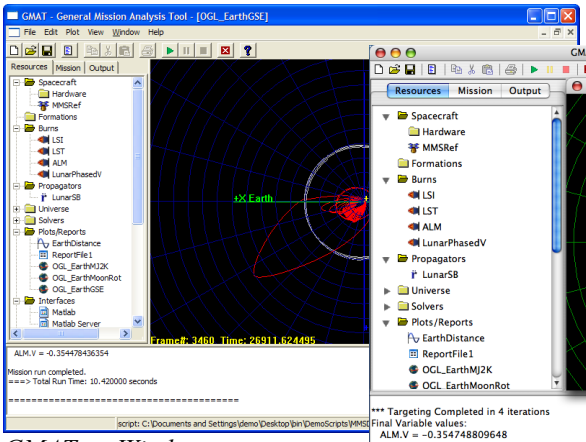
Development Approach

GMAT is written to run on Windows, Linux and Macintosh platforms, using the wxWidgets cross platform UI Framework, and can be built using either commercial development tools or the GNU Compiler Collection (gcc). The system is implemented in C++ using an Object Oriented methodology, with a rich class structure designed to make new features simple to incorporate. Extensive documentation is available that describes the architectural design, mathematical models and algorithms, testing procedures, system interfaces, and how to use GMAT.

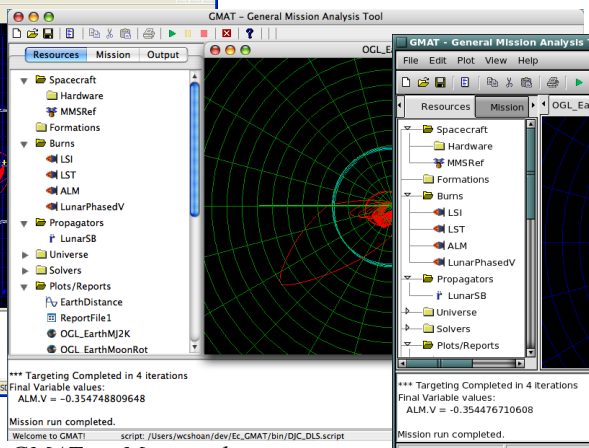
Project Status

While GMAT has undergone extensive testing and is mature software, we consider the software to be in Beta form. GMAT is not sufficiently verified to be used operationally. The optimization capabilities of GMAT have been used to develop optimal solutions for numerous missions. However, we independently verify these solutions in operational systems.

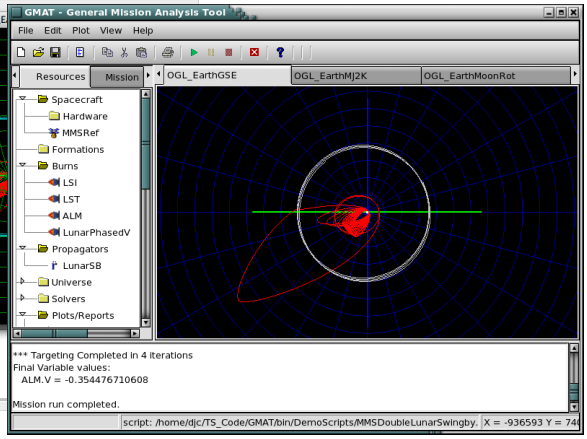
The GMAT Team is currently working on four activities: Maintenance and bug fixes, expanding the architectural specification, testing, and transitioning to an open source development process. The objective of the current development cycle is to provide a build for final beta testing in November 2007.



GMAT on Windows



GMAT on Macintosh



GMAT on Linux

Participation

The GMAT project has been a collaborative effort between NASA and industry partners at every step in the project lifecycle from requirements definition, to design, implementation, and testing. The project is currently transitioning to an open source development process. We invite interested parties to send us contact information so we can start to explore ways we can work together to make GMAT as useful as possible to the aerospace community. We welcome new contributors to the project, either as users providing feedback about the features of the system, or developers interested in contributing to the implementation of the system.

Partners to date include:

NASA Goddard Space Flight Center
Thinking Systems, Inc.
Computer Sciences Corporation
Honeywell Technology Solutions, Inc.

The following people can be contacted for additional information about the General Mission Analysis Tool.

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